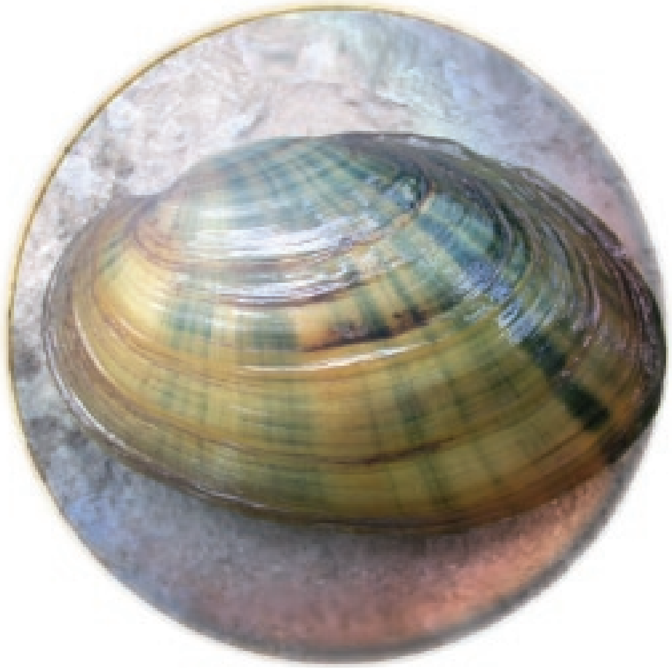
Our Goal:

All Waters in Region 5 Will Support Healthy Aquatic Biological Communities



In many ways, the portion of the Midwest that makes up Region 5 is defined by its water resources. These range from the major waters of the Great Lakes in the north to the great Ohio and Mississippi Rivers in the south. The region also includes the myriad of lakes, wetlands and trout streams of the northern forests and the prairie streams of the south. Thanks to this wide array of resources, Region 5 is host to a variety of plants and animals that reside in the water. The health of these organisms is an important indicator of the overall quality of the aquatic biological communities in the surface waters of the Midwest.

An "aquatic biological community" is the collection of plants and animals – microorganisms, algae, invertebrates, fish and other living things—that inhabit a body of water. Some, such as the region's many species of sport fish, are highly prized by anglers. Others, like wild rice, are culturally important as traditional staple foods. Still others, such as the different species of algae, aquatic insects and forage fish, are important links in both the water and land food webs. Taken as a whole, the plants and animals that live in our lakes, rivers and streams form the biological communities that we depend on for a multitude of uses, including food and recreation. Different components of the aquatic biological community respond in different ways to stressors such as the presence of pollutants, alteration of habitat or introduction of exotic species, resulting in changes in the community. Measuring aquatic community health provides direct information about the success of efforts to protect and restore the region's waters.

Water Quality Criteria and Standards

Water quality criteria are developed for specific chemicals to evaluate whether a water body is supporting aquatic life uses. Such criteria describe the minimum level of water quality necessary to allow a use to occur. EPA has developed water quality criteria for 157 pollutants to protect a variety of water body uses. States and tribes define the specific water body uses to be protected. A water body use and the water quality criterion developed to protect that use, together with an antidegradation policy, make up a water quality standard.

For more information on water quality standards and criteria, see http://www.epa.gov/waterscience/criteria or http://www.epa.gov/waterscience/standards.

How Is Aquatic Biological Community Health Assessed?

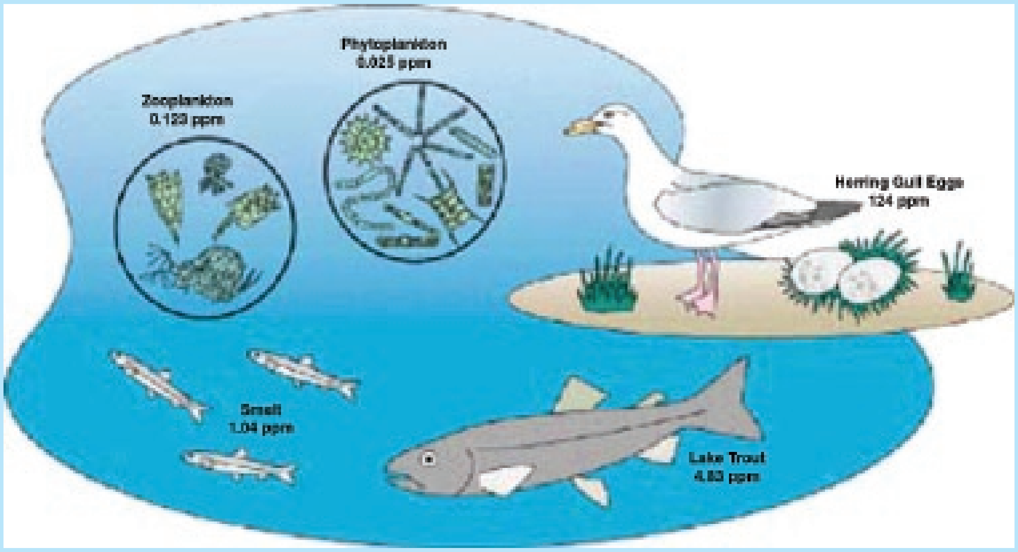
The health of aquatic biological communities can be assessed either directly by sampling plants and animals present in a water body or indirectly by measuring the chemical and physical quality of the water and comparing those measurements to established criteria. If the concentration of a pollutant in the water is greater than the corresponding water quality criterion, the health of the biological community may be adversely affected. Historically, chemical and physical measurements formed the basis for assessing aquatic community health. Recent development of direct measures of aquatic communities has allowed more accurate assessment of aquatic community health. Much of the information reported by the states on the status of their aquatic biological communities is now generated using these direct methods.

How Are Direct Measurements of Aquatic Biological Community Health Completed?

Direct measures of aquatic biological community health are based on assessments of how closely the biological community in a specific water body resembles the community that is expected to exist there in the absence of human-caused stressors.

The species of fish, invertebrates, algae and plants present as well as their condition and numbers provide direct information about the health of a water body and a means to efficiently assess the health of aquatic biological communities. The plants and animals therefore serve as biological indicators of community health. An indicator is a sign or signal about the status of a water body that can be used to assess the effects of a variety of stressors on that water body. A useful indicator is one that changes in a predictable way in response to biological, chemical or physical stressors in the water body.

Example Indicators of Biological Community Health



Source: EPA

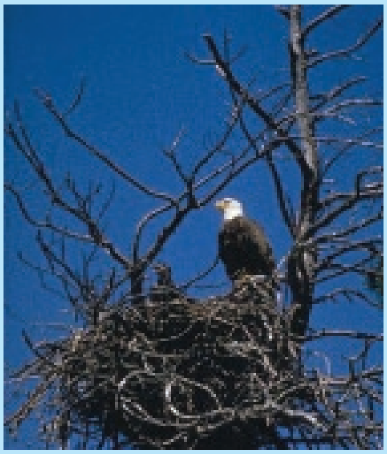
Levels of Toxic Contamination in Fish and Birds at the Top of the Food Chain

Certain human-made toxic chemicals present in a water body biologically accumulate (bioaccumulate) in organisms that live there. Even though these chemicals may be present at very low levels, through bioaccumulation, organisms such as phytoplankton can accumulate them at much higher concentrations than are found in the water. As the phytoplankton are eaten by zooplankton and small fish, the toxic chemicals are further concentrated in the bodies of the zooplankton and fish. This process is repeated at each step of the food chain and is known as biomagnification.

Shoreline Populations of Bald Eagles

Some pollutants and contaminants can be acutely toxic in relatively small amounts and can be harmful through long-term (chronic) exposure to minute concentrations. Aquatic and wildlife species have been intensively studied, and adverse effects such as crossbills and eggshell thinning in birds and tumors in fish are well documented. Evidence also suggests that polychlorinated biphenyls (PCB) and other contaminants may inhibit the reproduction of certain fish and wildlife species. For example, although they are greatly recovered from their decline in the 1960s, shoreline populations of bald eagles in the Great Lakes are having limited reproductive success compared to inland populations. These reproductive problems are likely caused by higher contaminant levels in the diet of the shoreline populations.

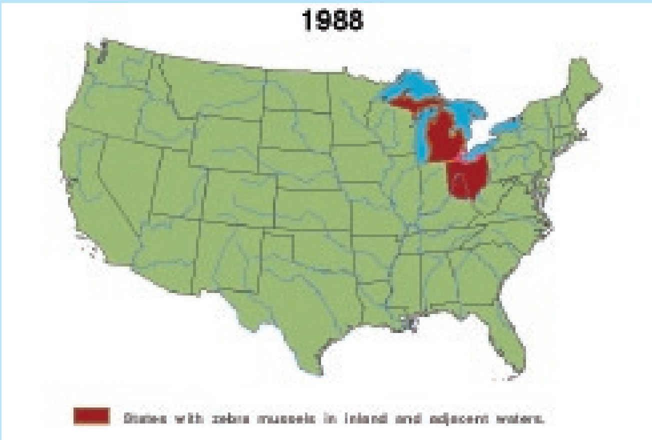
Source: EPA

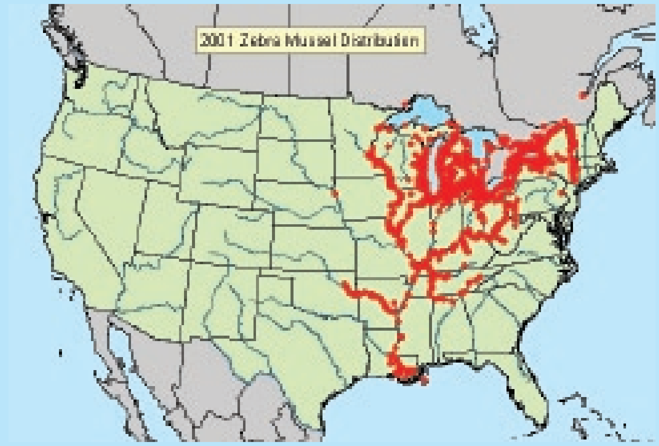


Bald Eagle and Young at Nest
Photograph by Don Simonelli, Michigan Travel Bureau

Aquatic Nuisance Species

Fish communities are the most visible indicators of water body health. To most people, they also represent one of the most important resources of the region's waters. Plankton communities (microscopic plants and animals) are the foundation of the food web and therefore are one of the most critical components of a water body's ecosystem. Changes to such communities may be occurring in the region as a result of the presence of contaminants and excessive nutrients in the water and sediment. In addition, exotic nuisance species such as the spiny water flea and zebra mussel are affecting aquatic ecosystems.





Source: U.S. Geological Survey

Zebra mussels were introduced to North America when they were discharged in the Great Lakes through a transatlantic ship's ballast discharge. The zebra mussel is now present in waterways throughout the eastern United States. Unlike native freshwater bivalves, which prefer to burrow into mud, the zebra mussel latches onto any hard surface it finds—rocks, pipes, boat hulls, other bivalves, and even sunken shopping carts. A million zebra mussels can cover 1 square meter. Their shells have impacted Great Lakes beaches. Great Lakes industrial facilities using surface water spent $120 million for zebra mussel monitoring and control between 1989 and 1994, according to the results of a 1995 survey by an Ohio Sea Grant researcher. Zebra mussels are also rearranging the ecosystems they invade. They filter vast amounts of water to consume microscopic phytoplankton. Although the filtering improves water clarity, it leaves less food for other organisms, with effects rippling through food webs. Native mollusks, for example, have disappeared from Lake St. Clair. Fishery populations in the Great Lakes are also being affected, although it will take years to sort out the specific impact of zebra mussels.

Zebra mussel on crayfish
Photograph Courtesy of Ontario Ministry of Natural Resources

More recently, an accidental release of the Asian carp in the Mississippi River has threatened the Mississippi River system and the Great Lakes. The Asian carp, which grow to 50 pounds, has no natural predators and competes for food with native fish. The carp has been seen 22 miles south of Lake Michigan in the Illinois River. The U.S. Army Corps of Engineers installed an experimental barrier in 2002 that many hope will prevent the Asian carp and other non-native species from spreading to the Great Lakes. It will also prevent migration of non-native species from Lake Michigan to the Mississippi River system.

Asian Carp
Photograph by Burr Fisher

What Does it Mean When an Aquatic Life Use Is Reported as Impaired or Not Attained?

Under the Clean Water Act, states and tribes designate uses for the surface waters within the states and reservations, respectively. The uses that states and tribes must consider in evaluating a particular water body include aquatic life, recreation, public water supplies, agricultural and industrial water supplies and navigation. An aquatic life use may be considered impaired if the aquatic community present at a site is significantly different from the expectations for the site or if the concentration of a particular pollutant or pollutants is greater than the criterion for that water body. The criteria are specific pollutant concentrations that protect specific uses. For example, if the concentration of copper is less than the aquatic life criterion, aquatic life in the water body should not be adversely affected by the copper.

What Do Assessments Conducted by the States Show?

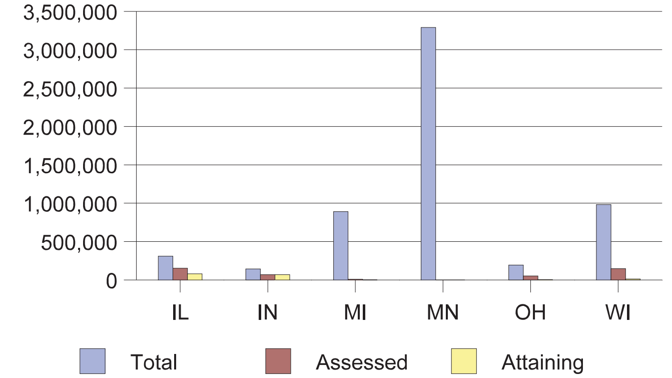
Every 2 years, the states report on the status of their water bodies. These reports are required under Section 305(b) of the Clean Water Act and are commonly referred to as "305(b) Reports." They are compiled into a National Water Quality Report to Congress. While the 305(b) Reports are not based solely on biological assessments (they include chemical and physical data assessments as well), they provide an overview of the status of aquatic biological communities.

Although 305(b) Reports provide a "snapshot" of water quality conditions, they do not reflect the status of all the water bodies within a state. As shown in Figures 1-1 and 1-2, states typically assess only a portion of the water bodies within their borders. For example, of the 87,110 miles of rivers and streams in Illinois, 15,304 miles were assessed for the 2002 305(b) Report, and 9,559 miles of the assessed streams were found to attain state water quality standards.

Of the 366,419 miles of rivers and streams in Region 5, 81,021 miles were assessed for the 2002 305(b) Reports (see Figure 1-3). A total of 54,982 of the miles assessed attained state water quality standards. This information compares favorably to data reported nationally, as Region 5 states both assess a greater percentage of river and stream miles than the national average and have a higher

Figure 1-1

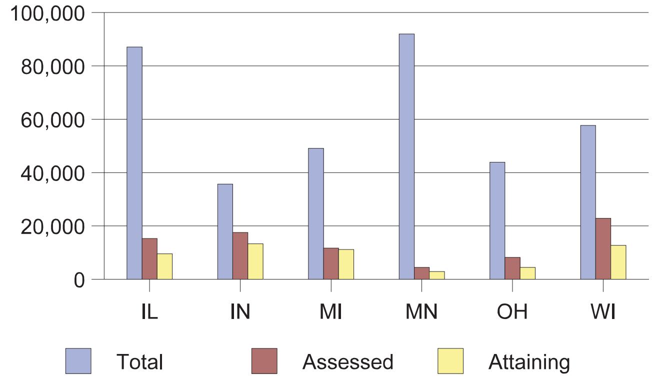
Inland Lakes (acres)



Source: 2002 State 305 (b) Reports

Figure 1-2

Rivers and Streams (miles)



Source: 2002 State 305 (b) Reports

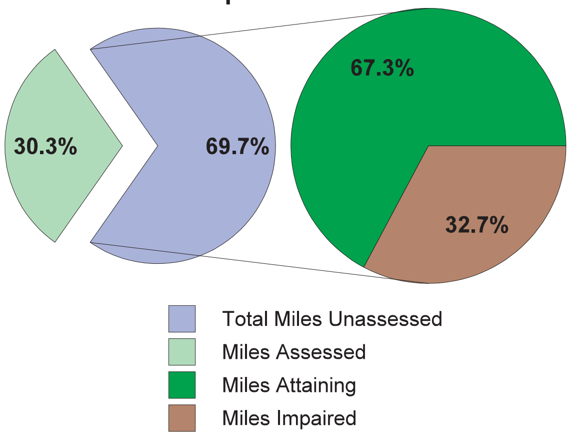
percentage of rivers and streams attaining water quality standards.

This type of summary provides useful information on the status of waters across the entire region as well as the capacity of state monitoring programs. Reporting the number of stream miles or lake acres assessed does not provide a measure of the distribution of sampling sites across a state or region, which is also important for accurately assessing water quality on a state or regional scale. For example, Ohio EPA visits each basin in the state once every 5 years. Each year, Ohio EPA staff visit 10 to 15 different study areas. Multiple sites in each study area are visited, bringing the total to 300 to 400 sampling sites per year. Biological, chemical and physical monitoring and assessment techniques are used at each site. Ohio EPA's approach for selecting sites ensures that the samples are representative of all the stream sizes within a watershed and that streams are covered across the state.

Figure 1-3

Aquatic Life Use: Rivers & Streams

Reported 2002

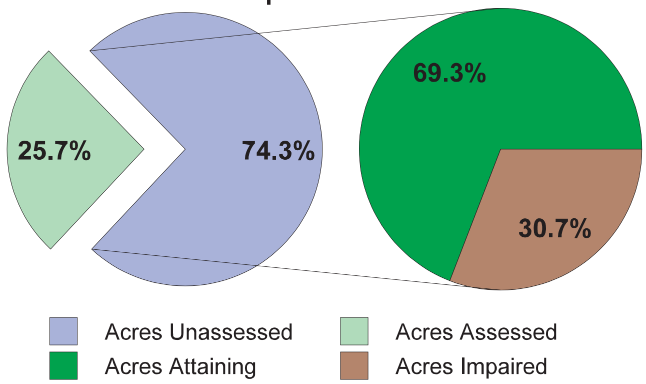


Source: 2002 State 305(b) Reports

Figure 1-4

Aquatic Life Use: Inland Lakes in Region

Reported 2002



Source: 2002 State 305(b) Reports

An urban stream showing relatively few effects of urbanization. This stream has intact stream bank vegetation, natural banks and some natural variation in stream width, depth and habitat.

Photograph by Edward Hammer, EPA

The same stream on the same day undergoing channelization for flood control. Channelization eliminates aquatic habitat, destroys stream bank vegetation and changes flow regimes, all major causes of impaired aquatic communities in Region 5.

Photograph by Edward Hammer, EPA

Illinois River Success Story Runs from Carp to Trophy Bass

In the l970s, the Illinois River could have served as the poster child for "Ugly Rivers." This important stream, which drains nearly a third of the state, was laden with trash, industrial waste and siltation. Nearly 30 years of point-source pollution control efforts since then have distinctly improved the river's water quality.

Thirty years ago, anglers' catches in the river were chiefly catfish and carp. As discharges received more effective treatment, the waters cleared, and sport fish as well as the macroinvertebrates they feed on returned. Today, anglers from throughout the Midwest are catching walleye, sauger, crappie and a variety of bass in the river. In 1995, Peoria was the site of a Professional Bass Masters Tournament, and there are many such tournaments along the river.

The focus for additional Illinois River improvements has shifted to nonpoint-source pollution. Several major plans have been developed to enlist landowner support for programs to reduce runoff and sedimentation. Under the Integrated Management Plan for the Illinois River, state government and leaders from agriculture, business and conservation are working in concert with the U.S. Department of Agriculture Natural Resource Conservation Service and its Conservation Reserve Enhancement Program (CREP), which was developed to enhance the Illinois River.

Illinois EPA has also channeled significant Clean Water Act Section 319 funding to CREP in order to implement conservation practices in environmentally sensitive areas.

Illinois EPA's success is indicated by the state's standing as the national leader in CREP enrollment. As of June 1, 2002, a total of 5,148 landowner agreements had been signed, with another 465 pending. So far, 122,370 acres have been enrolled in the program, which has a state goal of 132,000 acres.

CREP goals include reducing sedimentation and runoff; reducing phosphorus and nitrogen deposits in the river; increasing populations of waterfowl, shorebirds and state- and federally listed species; and increasing native fish and mussel stocks.

Region 5 states also provide information on the quality of their lakes. As with rivers and streams, states typically assess only a portion of their lakes. For example, of the 982,155 acres of inland lakes in Wisconsin, 146,479 acres were assessed for the 2002 305(b) Report, and 12,740 of the acres assessed attained state water quality standards.

Of the 5,801,970 acres of inland lakes in the region, 518,650 acres were assessed for the 2002 305(b) Reports (see Figure 1-4). A total of 348,320 of the acres assessed attained water quality standards. In contrast to the stream and river assessments, Region 5 states assess a lower percentage of lake acreage than the national average. This is due in part to the abundance of lakes in Region 5. On average, each EPA region has approximately 4,159,375 acres of lakes and reservoirs. With 5,801,970 acres, Region 5 has more than 1.5 million (39 percent) more lake acres than the regional average. Region 5 states report a greater percentage of lake acres attaining water quality standards as compared with national data.

Causes and Sources of Aquatic Life Use Impairments

In their 305(b) Reports, the states provide information about the causes of water body impairments and the sources of the pollutants responsible for the impairments. Figure 1-5 shows the causes of impairments for rivers and streams in Region 5, and Figure 1-6 shows the causes of impairments for inland lakes and reservoirs. These causes are ranked in descending order from those most frequently cited to those least frequently cited in the states' 2002 305(b) Reports.

Metals are most frequently cited as the cause of impairment of rivers and streams but not aquatic life impairment. Fish consumption advisories resulting from mercury contamination of fish account for most of the reported impairments. Toxic effects associated with metals, however, are actually responsible for only a small proportion of the reported impairments of aquatic community health. Based on the data gathered by the states, habitat alteration, siltation, nutrients, organic enrichment and low dissolved oxygen are the primary causes of adverse impacts on aquatic life. Pathogens, the primary cause of impairment of recreational uses, was a cause of impairment of 7 percent of the river and stream miles assessed.

The causes of aquatic life use impairments for lakes and reservoirs follow a similar pattern. Fish consumption advisories for mercury are the leading cause of impairment overall (greater than 100 percent because

Wisconsin lists all its surface waters as impaired as a result of fish tissue contamination with mercury). PCBs are the second most important cause of impairment because of fish consumption advisories (11 percent of impaired waters). The top causes of impaired aquatic communities in lakes and reservoirs (in order from most to least significant) are nutrients (18 percent), siltation (11 percent), excessive algal growth (10 percent), organic enrichment and low dissolved oxygen (8 percent), exotic species (8 percent), suspended solids (6 percent), noxious plants (4 percent) and turbidity (4 percent).

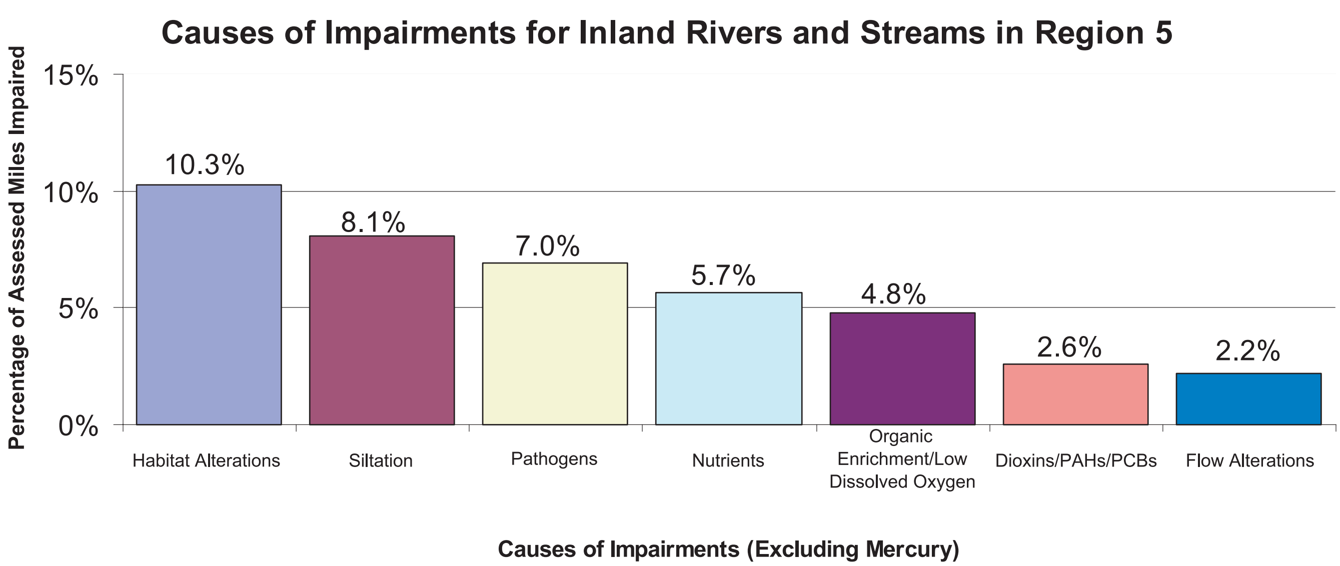
The states also report on the sources of the pollutants responsible for the reported causes of impairment. The primary source of impairments for rivers and streams is atmospheric deposition of pollutants (see Figure 1-7), which leads to such problems as high levels of mercury and other metals in these water bodies. Agriculture is also a major source of impairments because it causes such problems as high nutrient loads, contamination with pathogens, low dissolved oxygen levels, habitat alterations and siltation. Habitat modifications and hydromodifications (such as channelizing a river) are also major sources of impairment.

The sources of impairment for inland lakes and reservoirs are similar to those for rivers and streams. Figure 1-8 shows the sources of impairment and the percentages of the total assessed acres of inland

Improved Water Quality Through the Clean Michigan Initiative

Under Section 303(d) of the Clean Water Act, states are to list water bodies that are not in compliance with water quality standards. Michigan is working to remove water bodies from its impaired waters list (delisting) by controlling a variety of pollutant sources. As part of the Clean Michigan Initiative passed in 1998, specific funds were allocated to address nonpoint-source pollutant loadings. The nonpoint-source activities resulted in delisting of 10 water bodies, primarily because of actions that addressed sedimentation and animal access to water bodies. Michigan also delisted seven water bodies as a result of actions taken to correct point-source discharges. The water bodies now meet water quality standards, as has been shown by follow-up monitoring. In addition, seven water bodies included on the 2000 Section 303(d) list because of contaminated sediments have been delisted because the sediments have been remediated or are under order or contract to be remediated. These water bodies include the South Branch of the Black River, Manistique River, Pine River, Rouge River (Newburgh Lake), Saginaw River, Unnamed Tributary to Wolf Creek and Willow Run Creek.

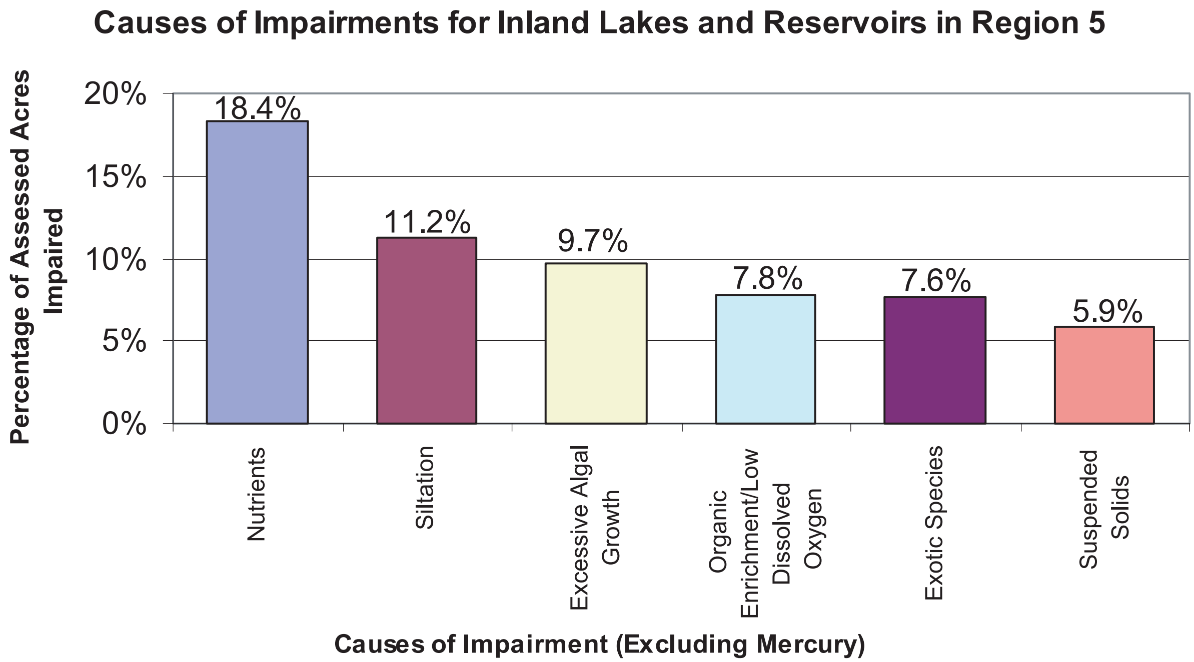
Figure 1-5



Note: PAH = Polynuclear aromatic hydrocarbon

Source: 2002 State 305(b) Reports

Figure 1-6



Source: 2002 State 305(b) Reports

lakes and reservoirs impaired by the sources based on 2002 data reported by the states. As with rivers and streams, atmospheric deposition is the most significant source of impairment, accounting for 77 percent of the lake and reservoir acres assessed as impaired. Atmospheric deposition is primarily responsible for the input of mercury into inland lakes and reservoirs, resulting in fish consumption advisories because of unacceptably high levels of mercury in fish tissue, but is not a significant cause of impaired aquatic communities. Other significant sources of impairment of lakes and reservoirs are agriculture (13 percent); habitat modifications (10 percent); forest, grassland and parkland (5 percent); hydromodifications (5 percent); and recreational activities (5 percent).

What Are We Doing to Address the Problems?

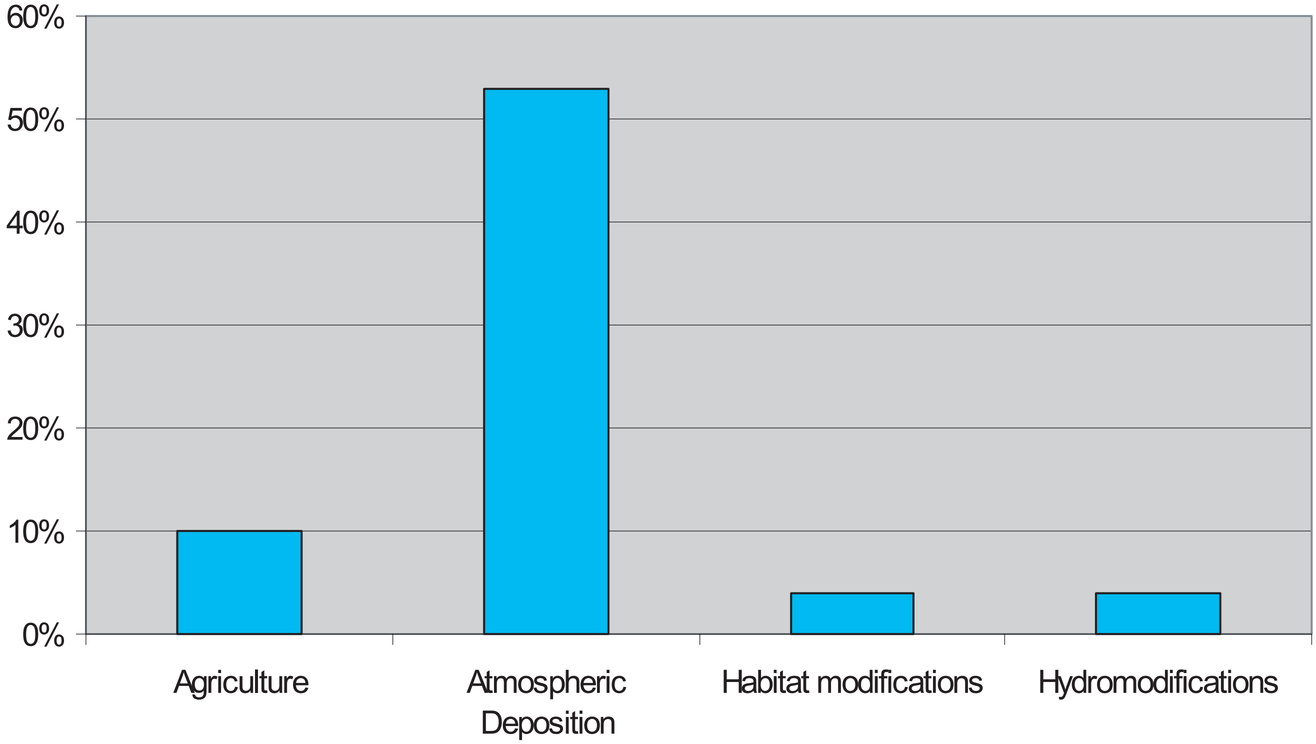
The impairments identified through the assessment process reveal how a healthy biological community can be disrupted. Because the problems are created by both point and nonpoint sources or pollution, solving them requires a combination of traditional and innovative approaches. EPA and the states are using a mixture of voluntary, incentive-based and regulatory tools to restore and protect aquatic biological communities.

Many problems originating from point sources have been addressed since the passage of the Clean Water Act in 1972, as is evidenced by the most often cited causes and sources in state 305(b) Reports. As a result of the Clean Water Act, all point-source dischargers to surface waters in the United States are required to obtain a permit to discharge. Such a permit includes limits on pollutants in the discharge that ensure that certain standards of wastewater treatment are achieved and that water quality standards will not be exceeded. Also, all states have water quality criteria for toxic pollutants. These criteria are intended to ensure that aquatic life is protected from toxic effects. To address water quality impacts resulting from nutrients, Region 5 states and tribes are developing water quality criteria that establish levels of nutrients that will not adversely affect surface waters.

As revealed by the state assessment process, nonpoint-source pollution and related issues are the leading cause of aquatic life impairment. State nonpoint- source programs established under Clean Water Act Section 319 target various problems facing aquatic communities. These programs reduce polluted runoff, restore habitat and improve water quality. The programs also promote education and outreach activities to increase public awareness about nonpoint-source

Figure 1-7

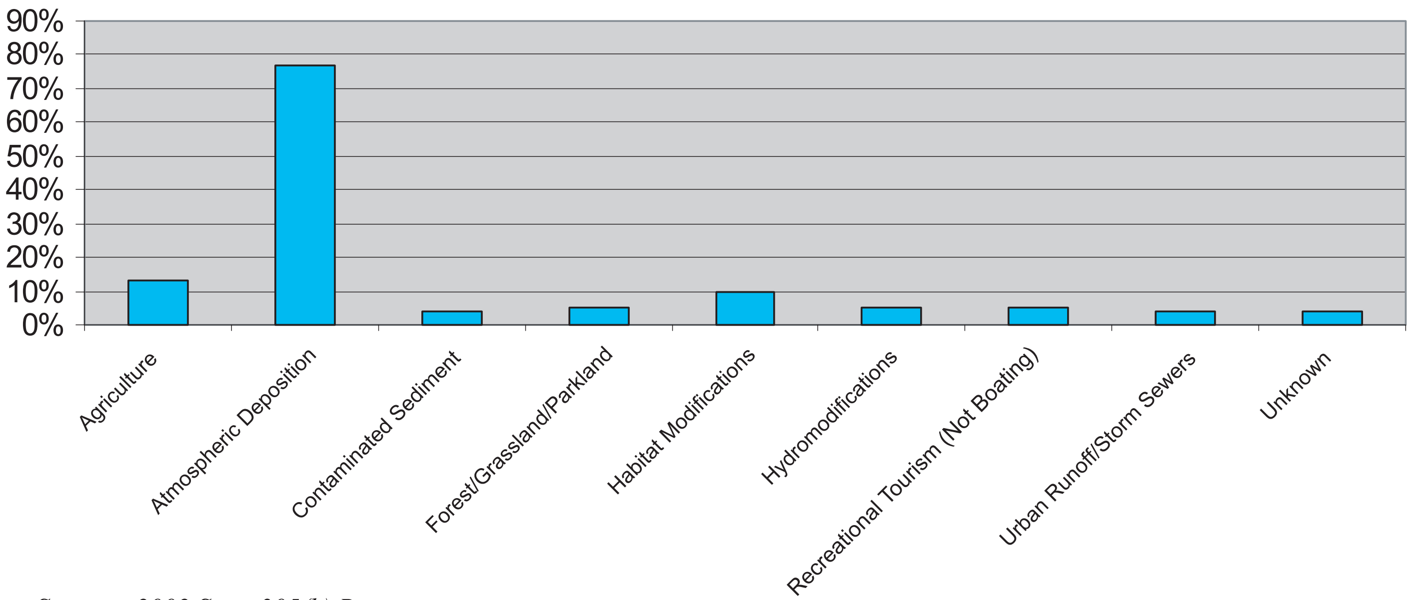
Major Sources of River and Stream Impairment in Region 5



Source: State 2002 305(b) Reports

Figure 1-8

Major Sources of Inland Lake and Reservoir Impairment in Region 5



Source: 2002 State 305(b) Reports

issues and to involve citizens in resolving problems. Examples of how nonpoint- source programs are being used to improve water quality, rehabilitate degraded habitat and restore natural flow regimes are provided the accompanying text boxes. For additional information on specific issues related to critical aquatic habitats, see Section 2.

Additional Data Sources

Biological Indicators of Watershed Health: http://www.epa.gov/bioindicators/

The Conservation of Biological Diversity in the Great Lakes Ecosystem: Issues and Opportunities: http://www.epa.gov/glnpo/ecopage/issues.html

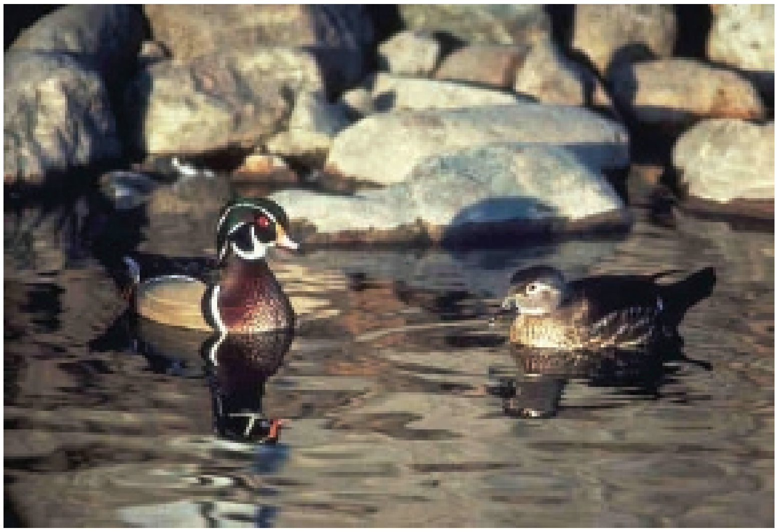
Sauk River Chain of Lakes Watershed in Minnesota

The Sauk River Chain of Lakes Watershed includes popular recreational water bodies between Richmond and Cold Sprint, Minnesota. Over the years the river suffered from increased nutrient and sediment loading, causing deterioration of water quality. In 1985, many partners and several EPA funding sources began a long-term, urban and rural, basin-wide nutrient and sediment reduction program. The Sauk River Watershed District and Stearns County have continued the effort with defined phosphorus management goals for each river tributary. Environmental results include a decrease in severe algal scums and signs of improved fisheries. Continued nutrient reductions will be cumulative and will improve water quality for recreation as well as the fisheries.

Source: EPA

Spring Creek Best Management Practices in Wisconsin

The Spring Creek Watershed Team in southeastern Wisconsin used EPA funding to encourage farmers to adopt a series of best management practices (BMP) in order to reduce runoff pollution. Watersheds where BMPs had been adopted were compared with watersheds where BMPs were not employed to address changes in stream habitat, reductions in fish and macroinvertebrate populations and stream bank erosion. Trout populations in Spring Creek improved after BMP implementation, and the stream's physical habitat and water quality have also improved. Spring Creek now meets water quality standards as a trout stream and is expected to be removed from Wisconsin's list of impaired waters.



Pair of Wood Ducks
Photograph Courtesy of
The National Park Service

Restoring Streams to Natural Flow Regimes in Michigan and Wisconsin

Improved Salmon Reproduction

For 80 years, hydroelectric dams caused large, daily fluctuations in water flow in western Michigan's Manistee River. Fluctuations such as these can impact the biological community in a stream by increasing erosion and either stranding or sweeping downstream the aquatic organisms that fish rely on for food. In 1989, the Manistee River hydroelectric dams began more natural "run-of-river flow management" consistent with conditions specified by the state in the dams' new hydropower licenses. As a result, stable flows were restored to the Manistee River.

Today, more young Chinook salmon survive as a result of the more stable flows in the Manistee River. Based on available sampling data, the number of young Chinook salmon entering Lake Michigan is estimated to have increased from 100,000 to 250,000 per year. Stable flows and erosion control projects have also increased the percentage of cobble and gravel in the first 1.7 kilometers downstream of the Tippy Dam from 63 percent of the stream bottom in 1990 to 82 percent in 1996. Cobble and gravel stream bottoms are important because they provide better habitat for fish and invertebrates.

Dam Removal

Wisconsin waters are impounded by over 3,500 dams. Returning rivers to a free-flowing condition eliminates safety risks posed by aging dams and improves the biological health of streams. Dam removal can also make sense economically, as the cost of repairing a small dam is on average 300 percent greater than the cost of removing a dam. In the last three decades, about 60 dams have been removed from Wisconsin streams–the largest number of dam removals in the nation.

The 1998 removal of the Waterworks Dam in Baraboo is an example of how dam removal can be a river restoration tool. Dams transformed the Baraboo Rapids segment of the Baraboo River from a fast-moving stream with healthy fish populations to a series of sluggish impoundments. The river once supported a spawning lake sturgeon population but became known for its carp. With removal of the dam, three-quarters of a mile of high-quality riffle habitat, which is rare in southern Wisconsin rivers, was restored to its free-flowing condition. Within 18 months of dam removal, water quality improved significantly, and the Wisconsin Department of Natural Resources found 24 species of fish in the newly free-flowing stretch of river, of which smallmouth bass was the dominant species. Partners in the project included the Wisconsin Department of Natural Resources, the City of Baraboo, the Baraboo River Canoe Club, the River Alliance of Wisconsin, the State Historical Society, Circus World Museum and many others.